Greenhouse Gasses/Alternate Energy
next class: in computer lab A119(off the caf)
Blackbody radiation - total and peak emission
absorption factors

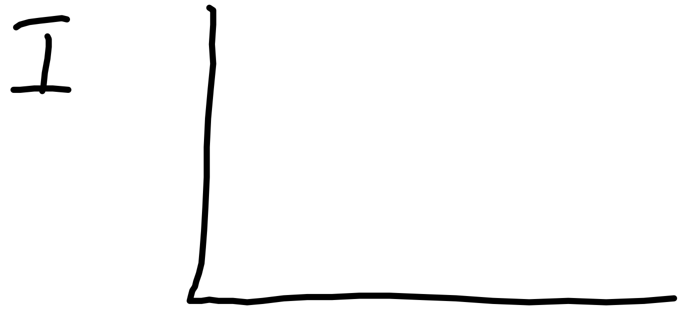
Blackbody - an ideal object that absorbs all wavelengths and emits all wavelengths of electromagnetic radiation.

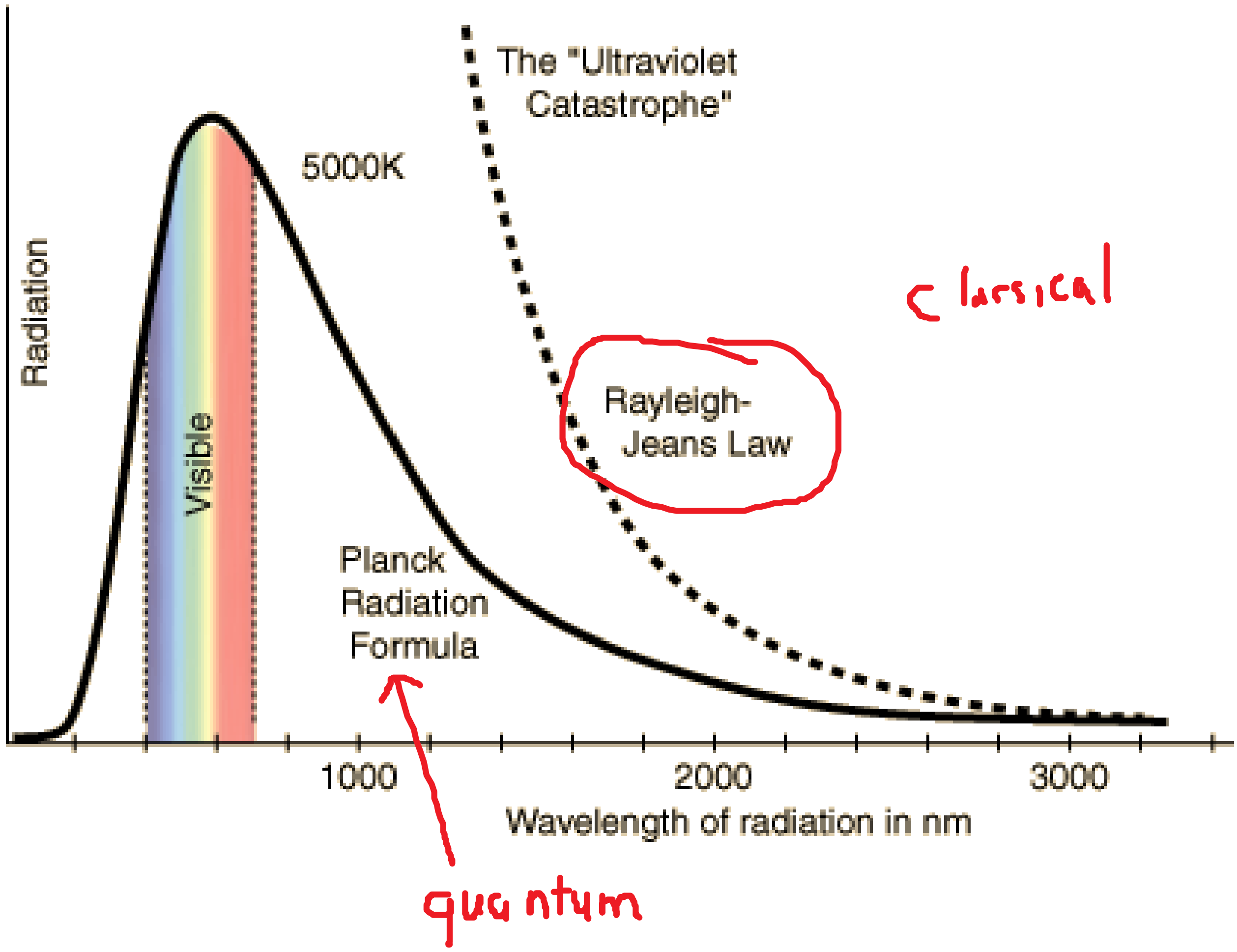
late 1800s Max Planck was hired by the German government to build a better lightbulb

used Maxwell's equations of electromagnetism and statistical mechanics to derive a relationship.

It didn't match observation.

it didn't match observation.





Planck assumed that EM radiation is quantized by E=hf energy of a photon
$h = 6.63 \times 10^{-34}$ Js
the new graph matched observation

The area under the graph corresponds to the total power output of the blackbody

$P = \varepsilon\sigma AT^4$

P is the total power output, in Watts.

A is the surface area of the object, in m^2. Sphere $A=4\pi r^2$

T is the temperature of the blackbody. must be in Kelvin!!!! +273 to get Kelvin from Celsius

σ is Stefan-Boltzmann constant = $5.67 \times 10^{-8}\ Wm^{-2}K^{-4}$

ε is emissivity for the object to be not a perfect blackbody. No units.

- emission coefficient -

the peak emission is dependent on the temperature.

$\lambda_{max} = (2.90 \times 10^{-3}\ mK)/T$

I, intensity = power/Area

albedo = total scattered power/(total incident power)

factors that influence albedo are: colour, reflectivity (amount of ice/water vs earth), texture,

eg.

The Sun has a radius of 695500km and a surface temperature of 5000K.

a) what is the total power output of the sun if it is an ideal blackbody $\varepsilon=1$

$P = \varepsilon\sigma AT^4$

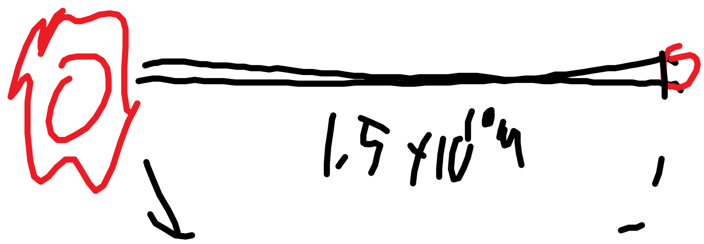
$P= 1 \times 5.67\times10^{-8}\ Wm^{-2}K^{-4}$
$\times(4\times pi\times(6.955\times10^{8}m)^2) \times (5000K)^4$
$2.15\times10^{26}W$

b) The Earth has a radius of 6.371×10^6m and an average surface temperature of 15ºC and an emissivity of 0.5. What is the total power output of the Earth?

P= 0.5 x 5.67x10^{-8} Wm^{-2}K^{-4} x(4xpix(6.371x10^{6}m)^{2}) x (15+273K)^{4}
= 9.95x10^{16}W
0.5x5.67E-8x4x3.14159x6.37E6^2x288^4=9.94515E16

a) The Sun is 1.5x10^{10}m away from the Earth. Calculate the energy per unit area (intensity) of sunlight on Earth assuming solution from a. (think of the Earth as a disc on a sphere radius 1.5x10^{10}m)

$P = P_T \times \frac{A_E}{A_{sphere}}$



A_E = disc = πr^2 = 3.14159x(6.371E6^2)=1.27516E14

A_{sphere} = 4πr^2 = 4x3.14159x(1.5E10^2)=2.82743E21

P = 2.15E26x1.27516E14/2.82743E21= 9.69642E18 W power into the earth

if that spread over the disc
9.69642E18/1.27516E14=
76,040.81056 = 76kW/m^2

a) What albedo would make the solution to b (output energy) match the solution to c (input energy)?
b) what is the peak emission wavelength for Sun and the Earth?